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**Datasheet for the decision
of 10 July 2009**

Case Number: T 0680/09 - 3.2.06

Application Number: 01301949.2

Publication Number: 1153699

IPC: F01D 5/00

Language of the proceedings: EN

Title of invention:

Blink weld repair

Applicant:

GENERAL ELECTRIC COMPANY

Headword:

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Relevant legal provisions:

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Relevant legal provisions (EPC 1973):

EPC Art. 56, 84

Keyword:

"Appeal - admissible (yes)"

"Main and auxiliary requests - lack of inventive step"

Decisions cited:

-

Catchword:

-



Case Number: T 0680/09 - 3.2.06

D E C I S I O N
of the Technical Board of Appeal 3.2.06
of 10 July 2009

Appellant: GENERAL ELECTRIC COMPANY
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Representative: Bedford, Grand Richard
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 5 November 2008
refusing European application No. 01301949.2
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: P. Alting Van Geusau
Members: M. Harrison
K. Garnett

Summary of Facts and Submissions

- I. The appellant (applicant) filed an appeal against the decision of the examining division refusing European patent application No. 01301949.2.
- II. In its decision the examining division found that the subject matter of claim 1 of the applicant's only request lacked an inventive step, and that the dependent claims 2, 3 and 5 repeated features that were in claim 1 and lacked conciseness (Article 84 EPC 1973).

The examining division's decision concerning lack of inventive step of claim 1 was based on the following documents:

D1: US 5 479 704
D3: US 4 940 390
D5: WO 97/25156

- III. In its grounds of appeal, the appellant requested that the decision under appeal be set aside and that a patent be granted based on the claims of its main request, including claim 1 which was identical to that upon which the examining division had reached its decision but wherein claim 3 had been deleted for conciseness, leaving previous claims 2, 4 and 5 unamended. An auxiliary request was also filed containing dependent claims 2 and 3, corresponding to dependent claims 2 and 4 of the main request.
- IV. The Board issued a summons to oral proceedings together with an annex containing its provisional opinion stating first that the question of admissibility of the

appeal needed to be discussed. It was also stated *inter alia* that claim 1 lacked clarity and that the subject matter of claim 1 of each request appeared to lack an inventive step.

- V. In its letter of 9 June 2009, the appellant replaced its requests by new main and first auxiliary requests, whereby the main request contained an independent claim and only one dependent claim and the first auxiliary request contained only an independent claim.
- VI. Oral proceedings were held before the Board on 10 July 2009, during which the appellant confirmed its requests.
- VII. Claim 1 of the main request reads as follows:

"A method of repairing a blisk (10) having a row of airfoils (14), said method comprising: machining away damage (18) from one of said airfoils to create a notch (28) therein having a predetermined configuration and size which is larger in area than said damage; welding a repair (32) in said airfoil to fill said notch; and machining said repair (32) to restore said airfoil to a substantially original, pre-damaged configuration at said repair wherein the step of machining away damage (18) is accomplished in a multi-axis numerically controlled milling machine (30); and the step of welding a repair (32) in said airfoil to fill said notch is accomplished in a multi-axis numerically controlled welding machine; and further comprising initiating and terminating said repair welding outside said notch (28); the method characterized by the steps of: analyzing stress of said blisk to determine maximum airfoil stress thereof during operation; specifying the

predetermined notch size and location to exclude airfoil locations subject to said maximum stress; wherein said notch size is uniform for all of said airfoils (14) in said blisk (10) irrespective of damage area therein."

VIII. Claim 1 of the first auxiliary request includes the following features added to claim 1 of the main request:

"wherein said notch (28) is positioned along leading or trailing edges (24, 26) of said airfoil (14), and spaced outboard from a root (20) thereof, said notch (28) having an arcuate profile along said airfoil (14) and said repair (32) being formed in layers to fill said notch (28)."

IX. The arguments of the appellant may be summarised as follows:

The appeal was admissible since claim 3 had been deleted in the main request compared to the claims before the examining division thereby giving conciseness to the claims.

The subject matter of claim 1 of the main request involved an inventive step starting from D1 as the closest prior art. D1 disclosed the features of claim 1 up to and including the words "...configuration at said repair" apart from the feature of being a method of repairing a "blisk", because the method was intended for use on separate turbine blades attached to a disk and not a blisk. The "characterized in that" wording was incorrectly placed. D1 also did not disclose a predetermined notch location, only a predetermined

notch size. Also, the notch was only optional as was clear from e.g. column 1, lines 13 to 21 and column 6, line 38, since it only concerned local damage, and was thus not "standardised" or "irrespective of damage" as claimed. The objective problem to be solved over D1 was to provide a high quality weld repair in an automated manner. It was not obvious to use a standardised cut in an area excluding areas of high stress when starting from D1, because the semi-circular repair in D1 involved using a notch which was in an area of high stress, whereas the applicant would simply discard blisks with such damage. In D1, the position of the cuts was not dependent on avoiding areas of high stress, but on areas which were easily accessible for joining. Also, the method in D1 involved a repair concerning adding of several plates radially which was not the same as the invention described.

In respect of the auxiliary request, D3 disclosed cutting away a turreted airfoil connection and reforming it, not performing a blisk repair, and since it did not disclose repairing a notch it was incompatible with D1 and the method of repair disclosed in claim 1.

Reasons for the Decision

1. Admissibility of the appeal

The decision under appeal rejected the sole request for both lack of inventive step in the subject matter of claim 1 and for lack of conciseness of the claims due to repetition (Article 84 EPC 1973). The arguments in the appellant's grounds of appeal concerning the

reasons for which the subject matter of claim 1 involved an inventive step provided sufficient substantiation for the Board to understand why the appellant was of the opinion that the decision should be overturned in that regard. Concerning the objection to conciseness, the appellant stated in its appeal grounds that "the claims have been amended for conciseness by cancelling the subject matter of previous claim 3". Thus the Board can recognise that this was an attempt to overcome the objection to conciseness of the claims when seen as a whole, and is thus able to understand why the appellant was of the opinion that the decision should be overturned in that regard by means of its amendment. By way of claim deletion being performed specifically to meet this objection when supplying its grounds of appeal, a substantiation for overturning the decision in this regard is thus present.

Since no other matters concerning the admissibility of the appeal arise in this matter, the Board concludes that the appeal is admissible.

2. *Main request*

2.1 In view of the amendments made to the claims, whereby only a single dependent claim remained which does not repeat any of the features in claim 1, the objection to lack of conciseness (Article 84 EPC 1973) is overcome.

2.2 In respect of inventive step and of the documents cited, D1 is considered to be the closest prior art starting point and this is also agreed by the appellant.

2.2.1 Contrary to the appellant's submission however, D1 indeed concerns the repair of "blisks" (i.e. an integral rotor disk with blades, as described in the application at paragraph [0004]). In particular, D1 discloses the repair process in the specific context of the "repair of blades for integral rotor disks of a turboengine" as being a preferred use (see e.g. column 5, lines 33 to 40). D1 even provides an example (Example 1) specifically describing the process carried out on such an integral rotor disk (see column 6, lines 35 to 42). The appellant's argument in this regard that the process of D1 was only intended for use in repairing separate disk blades mounted on a rotor disk finds no support in D1, and the repair of separate rotor blades mounted on a rotor disk is merely given as an alternative to the repair of blisks.

2.2.2 The appellant further argued that D1 did not disclose a predetermined notch location, but merely a notch size. The Board is however unconvinced by the appellant's argument. In column 6, lines 35 to 41 of D1, it is disclosed that "one or more standardized separation cuts 10 - 15, are made", whereby separation cut 15 is a semicircular cut (see column 6, lines 46 to 53). Moreover, standardizing of the cuts is explained in column 7, lines 6 to 10 as being such that the cuts "do not have to be adapted individually to each blade". Thus the cuts are predetermined in both size and location, as anything else would require being adapted individually for each blade and thus contrary to D1.

Whilst D1 also discloses, very generally, in column 1, lines 13 to 21 that the separation of the damaged portion depends on how and where the blade is damaged,

- this does not detract from the fact that in the specific case of Example 1 it is explained how standardizing is performed.
- 2.2.3 D1 also discloses (see column 6, lines 43 to 61) that "the standardizing of the separation cuts is obtained on the basis of" distribution of stress, reasons of accessibility and on the occurrence of damage due to effects of foreign objects, and that the separation is performed so as to leave a blade stump of sound material. As is evident from this, the separation cuts are therefore of such a size and in such a location that the separation is made outside areas of maximum stress, because the distribution of stress is taken into account when providing the standardized separation cuts which results in the stump of sound material.
- 2.2.4 The last feature of claim 1, according to which the notch size is uniform for all of said airfoils in said blisk irrespective of damage area therein, is also known from D1, since the cuts are "standardised" and in as far as the word "uniform" in claim 1 can be understood, this has the same meaning as "standardized" in this context because the standardizing in D1 is such that no individual adaptation is required for each blade.
- 2.2.5 The step of welding a repair in said airfoil to fill said notch by means of a multi-axis numerically controlled welding machine is also disclosed, since in Example 1 three welding types may be used (see e.g. column 8, lines 1 to 6) and in column 5, lines 25 to 32 it is explained that a seam tracking system for detection and automatic butt welding is provided,

whereby also curved welds can be precisely produced.
This was also not disputed by the appellant.

2.3 Since, in Example 1, it is only stated that the removal of material is by way of a laser beam (column 7, line 21 to 53), the only features of claim 1 which are not disclosed in D1 are the following:

(a) machining away damage is accomplished in a multi-axis numerically controlled milling machine;

(b) initiating and terminating said repair welding outside said notch.

2.4 The appellant stated that the objective problem to be solved over D1 was to provide a high quality weld repair in an automated manner. However, the Board finds that this problem is not objective, since no evidence has been provided that D1 does not itself produce a high quality weld, and the weld is quite evidently already produced in an automated manner.

2.4.1 The two features (a) and (b) identified above do not solve a common problem, but independent problems; feature (a) solving the problem of providing an alternative method of automated cutting of an airfoil, and feature (b) solving the problem of avoiding non-homogeneous locations at the start and end of a weld.

2.4.2 Regarding feature (a), the use of numerically controlled milling as a method of removing material in an airfoil for its subsequent repair is known from D5 (see e.g. page 9, lines 5 to 8) where it is given as an alternative to a procedure of cutting by erosion. A

skilled person wishing to provide an alternative method of automated cutting of an airfoil is thus taught that numerically controlled milling is a suitable method for this purpose and would apply such a method where the circumstances make it appropriate, without needing to use inventive skill. It is also implicit that a numerical controlled machine has several degrees of freedom. This feature was also found to be obvious by the examining division when considering the teaching of D5 and the appellant has not challenged that finding.

2.4.3 Regarding feature (b), the skilled person is taught by e.g. D3 (see column 8, lines 50 to 54), that run-off tabs are used for starting and stopping a weld since at those locations metallurgical defects may be caused. A skilled person wishing to solve the problem of avoiding non-homogeneous locations would thus adopt the teaching of D5 and use this in the method of D1. As stated with regard to feature (a), this feature was also found to be obvious by the examining division when considering the teaching of D3 and the appellant has not challenged that finding.

2.5 The appellant argued that D1 involved building up a weld repair in layers by adding several plates radially and that this was not the same as the method described in the patent. However, nothing in claim 1 defines the manner of performing a repair which differs over D1; claim 1 merely defines "welding a repair in said airfoil". How the repair material is constructed in a way which might be different from D1 is not defined.

2.6 The subject matter of claim 1 consequently lacks an inventive step such that the requirement of Article 56

EPC 1973 is not fulfilled. The main request is therefore not allowable.

3. *Auxiliary request*

3.1 Of the additional features added to claim 1 of the main request, the feature "said notch is positioned along leading or trailing edges of said airfoil, and spaced outboard from a root thereof, said notch having an arcuate profile along said airfoil" is disclosed already in D1, due to the fact that notch 15 is semicircular, and is located well away from the root (almost half way up the airfoil) on the trailing edge (see e.g. Figure 1b and column 6, lines 48 to 53).

3.2 Thus, the only feature added to claim 1 of the main request which is not disclosed in D1 is "said repair being formed in layers to fill said notch".

Starting from D1, this feature solves the problem of making the repair by an alternative method of forming a weld compared to the welding of a plate, wherein such welding should result in defect-free welded layers (see e.g. the published application column 7, lines 6 to 14).

3.3 D3 discloses the feature of providing a weld repair by forming a repair in layers (see e.g. column 3, lines 44 to 50 and the Figures). In D3, the specific embodiment concerns the repair of a turret type connection of a turbine blade to a disk, but in column 1, lines 38 to 41 it is disclosed that the method also relates to repair procedures for worn or damaged surface of turbine components and to welding techniques for

building up these worn surfaces with sound metal deposits. Thus, contrary to the appellant's submission, D3 is not incompatible with D1 as its teaching to a skilled person clearly is that it is applicable to turbine components in general and not merely repairing a damaged turret (steeple) connection, such that whilst D3 is not directed specifically to the repair of a notch, D3 teaches building up of layers to provide a weld with minimised defects in a turbine. This teaching would thus equally be applied to the repair of a notch in a turbine application. In particular, there is no feature of the notch defined in claim 1 which alters this opinion, as the notch is merely defined as being arcuate and thus implies nothing which might cause the method of D3 not to be compatible with some aspect thereof. Likewise, nothing in D3 indicates that such a method would be incompatible with the welding of the notch as shown in D1.

Further, D3 notes (see e.g. column 1, lines 51 and 52) that prior art repairs are already known involving welding of individual pieces to worn rotors or discs, and that the invention in D3 (see e.g. column 3, lines 1 to 62) relates to minimization of defects and achieves this by welding in layers.

The skilled person is therefore taught by D3 that an alternative to welding a plate in place as a repair is to use welding in layers, and that this minimises defects. The skilled person would thus use this teaching in place of the method of welding in a plate as in D1, and thus arrive at the subject matter of claim 1 without using inventive skill.

3.4 Consequently, the subject matter of claim 1 does not involve an inventive step and thus does not fulfil the requirement of Article 56 EPC 1973.

The request is therefore not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

M. Patin

P. Alting van Geusau